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(54) A METHOD OF AND APPARATUS FOR PREPARING A MIXTURE OF PLURALITY OF LIQUIDS

(71) We, FUJI SHASHIN FILM KABUSHIKI KAISHA, a Japanese Company, of No. 210 Nakanuma, Minami-Ashigara Machi, Ashigara-Kamigum, Kanagawa, Japan, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a method of and apparatus for preparing a mixture of a plurality of liquids and is particularly applicable to liquids the properties of which are prone to change with time.

It is an object of this invention to provide an improved method of, and an apparatus for, preparing a mixture of a plurality of liquids and it is a further object to provide such a method which lends itself to automatically and continuously preparing a mixture of automatically and continuously preparing a mixture of liquids such as pure liquids, solution, colloidal solutions, and solutions of high polymers, which are dissolved during the preparation of the mixture, by adding them in the predetermined addition order and after predetermined addition intervals, and wherein the liquids to be mixed are accurately measured in a definite quantity needed so that the time from the start of preparation of the mixture to the end of use is within that allowed considering the change with time of the properties of the mixture.

The conventional process of manufacturing a coating solution for a photosensitive material, such as a coating solution of a photosensitive emulsion layer, a coating solution of a protective layer, a coating solution of an anti-halation layer, and a coating solution of a subbing layer, is a batch manufacturing process wherein a quantity of liquid emulsion or gelatin depending on the size of the mixing tank used in melted or dissolved and some addition agents of liquids or solutions are measured so as to be a definite mixing proportion to the solution of said emulsion or gelatin and added to the solution in the order such that the addition agents do not affect one another, and are mixed by stirring.

However, in this conventional batch manufacturing process, there are accompanying disadvantages in that fluctuation often occurs of the physical properties and photographic characteristics to be controlled in the coating solution mixed in the mixing tank, a switch operation is needed for switching the tanks in order to supply the coating solutions continuously to the coating head for continuous coating and, because of the large number of individual operations required for making a batch at solution, a large quantity of solution has to be made at once for efficient production. Moreover, during the time from start of mixing of the coating solution to the end of using them, the physical properties of the coating solution to be controlled in the coating process fluctuates and the gelatin in the coating solution partly coagulates, and the addition agents containing in the mixed coating solution affect the photographic characteristics singly or mutually and this greatly affects the manufacture of photosensitive material.

The tendency to fluctuation is considerably increased with the concentration of the coating solution which accompanies an increase of the coating speed for the purpose of increasing productivity and with the increase of the proportion of silver halide contained in the coating solution which accompanies improvement in the quality of photosensitive material. For this reason in the conventional batch manufacturing process it has become extremely difficult to eliminate fluctuation, and improvement of the batch manufacturing process is required. The above mentioned disadvantages in the manufacturing process are eliminated by making the manufacturing process completely continuous, but on the other hand the continuous process is generally unsuitable for small scale production of photo-

[P]

graphic material, and there are many problems to be solved in that the kinds and amounts of addition agents are various and that high accuracy of the quantities of the addition agents is needed in the addition process. Moreover, it is desired that the exchange of the addition agent and the regulating of the addition interval or addition order are easily carried out in dependence on the type of the manufacured photosensitive material, that the manufacturing apparatus is easily cleaned and reconstructed when manufacturing conditions are changed, that the operation conditions of the manufacturing apparatus stabilize quickly, and the measuring of the quantity the addition agents used is easy and accurate. For a continuous process, a complicated and expensive apparatus is needed and it must be carefully cared for and treated. It is therefore very difficult to accomplished the object effectively by making the manufacturing process continuous in the many kinds and small production scale.

Another object of the present invention is to provide an automatic and continuous method of adding and mixing, for instance, a coating solution for a photosensitive material, wherein the liquids to be added and mixed are divided into small quantity of mixing units in order not to affect the properties of the liquids to be mixed within the period from the start of manufacture to the end of use and the measure error of the emulsion-gelatin solution and the addition agents is reduced by being divided into larger quantity of units compared to continuous process.

According to one aspect of this invention there is provided a method of preparing a mixture of a plurality of liquids in an apparatus comprising a mixing tank and, for each liquid, a control tank the liquid level in which is controlled, a measure cylinder having at its upper end a nozzle connected to the lower end of the control tank and a further nozzle at its lower end, and an overflow level setting pipe which is connected at its lower end to the nozzle at the lower end of the measure cylinder and which has an overflow nozzle leading to the mixing tank, the method comprising adding each liquid to the mixing tank by moving the appropriate measure cylinder downwardly to the extent that the nozzle at the upper end of the measure cylinder is below the liquid level of the associated control tank and subsequently moving the measure cylinder upwardly to the extent that the nozzle at the upper end of the measure cylinder is above the overflow nozzle of the associated overflow level setting pipe, the liquids being added in a predetermined order and at predetermined intervals, mixing the liquids in the mixing tank by stirring, and forwarding the mixed mixture continuously t the next process.

According to another aspect of this invention there is provided apparatus for preparing a mixture of a plurality of liquids comprising a mixture tank and, for each liquid, a control tank the liquid level of which is controlled, a measure cylinder having a n zzle at its upper end which is connected to the lower end of the control tank, and a nozzle at its lower end, and an overflow level setting pipe the lower end of which is connected to the nozzle at the lower end of the measure cylinder and which has an overflow nozzle, which leads to the mixing tank, an actuating means for each measure cylinder for moving that measure cylinder downwardly to the extent that the nozzle at its upper end is below the liquid level in the associated control tank and for subsequently moving that measure cylinder upwardly so that the nozzle at its upper end is above the overflow nozzle of the associated overflow level setting pipe, means for mixing the liquids in the mixing tank, and means for forwarding the mixed liquids continuously to a further process.

An embodiment of this invention will now be described, by way of example only, with reference to the accompanying drawings in which:—

Figure 1 is a schematic view of apparatus embodying the present invention.

Figures 2, 3, 4 and 5 are schematic side views illustrating the operation of parts of the apparatus; and

Figure 6 is a schematic view illustrating the control system of the apparatus.

Referring to Figure 1, the reference characters R_1—R_n denote liquid supply tanks for storing the liquids and solutions, C_1—C_n denote control tanks of the liquids and solutions, M_1—M_n denote measure cylinders for the liquids and solutions, O_1—O_n denote overflow level setting pipes, and ST denotes a coating solution mixing tank for mixing by stirring and added liquids and solutions.

Figures 2, 3, 4 and 5 illustrate the measuring method used in this apparatus and in these Figures, the reference character C_1 denotes a control tank, M_1 denotes a measure cylinder, N_{U1} denotes a side nozzle disposed at the upper side portion of the measure cylinder M_1, N_{B1} denotes a bottom nozzle disposed at the bottom of the measure cylinder M_1, N_{F1} denotes an overflow nozzle disposed on the overflow level setting pipe O_1, H_1 denotes the difference between the level of the liquid in the control tank C_1 and the level of the side nozzle N_{U1} of the measure cylinder M_1 at the lowest position of the up and down movement thereof, h_1 denotes the difference between the level of the overflow nozzle N_{F1} of the overflow level setting pipe O_1 and the level of the liquid in the control tank C_1 at the lowest position of the up and down movement of the measure

cylinder M_1, L_1 denotes the difference in levels between the overflow nozzle N_{F1} of the overflow level setting pipe O_1 and the side nozzle N_{U1} of the measure cylinder M_1 at the highest position of the up and down movement thereof. It will be seen that the distance $H_1+h_1+L_1$ is equal to the total up and down movement of the measure cylinder M_1. d_1 denotes the difference in levels between the overflow nozzle N_{F1} and the side nozzle N_{U1} after a predetermined quantity of liquid is in the measure cylinder M_1 after removal of the excess amount of liquid in the measure cylinder M_1 by moving it upwardly to the extent that the nozzle N_{U1} is in line with the liquid in the control tank C_1, D_1 denotes the difference in levels between the overflow nozzle N_{F1} and the side nozzle N_{U1} when the liquid is starting to flow out through the overflow pipe O_1 and the overflow nozzle N_{F1}. Fig. 2 shows that state when the liquid has ceased to flow into the measure cylinder M_1 from the control tank C_1 through the side nozzle N_{U1}, Fig. 3 shows the state when the predetermined added quantity of liquid is in the measure cylinder M_1 after removal of the excess amount of liquid in the measure cylinder M_1 during its upward movement, Fig. 4 shows the state when the level of the liquid in the measure cylinder M_1 reaches the level of the overflow nozzle N_{F1} and the liquid in the measure cylinder M_1 starts to flow out through the bottom nozzle N_{B1}, overflow pipe O_1 and overflow nozzle N_{F1}, and Fig. 5 shows the state when the predetermined amount of liquid has ceased to flow out from the measure cylinder M_1 to the coating solution mixing tank ST through the overflow level setting pipe O_1 and overflow nozzle N_{F1}.

In detail, the prepared addition agent is forwarded to the measure cylinder M_1 from the supply tank R_1 through the control tank C_1 by the up and down movement of the measure cylinder M_1, and measured into the predetermined quantity by the measure cylinder M_1 and the overflow level setting pipe O_1 and added into the mixing tank ST to be stirred and mixed with the other liquids added thereto.

In this case, the volume to be measured can be varied by varying the level of the overflow level setting pipe O_1, changing the size of the measure cylinder M_1, and varying the upper limit of the up and down movement of the measure cylinder M_1.

One cycle of the measuring and adding operation will now be described.

Initially the measure cylinder M_1 which moves up and down through the length of $H_1+h_1+L_1$ is at the lowest position of its up and down movement (shown in Fig. 2), and the liquid to be measured flows into control tank C_1 to the controlled level from the supply tank R_1, and then flows into the measure cylinder M_1 the side nozzle N_{U1} of which is positioned through the distance H_1 lower than the level of the control tank C_1, when the measure cylinder M_1 is at the lowest position in its up and down movement, through the side nozzle N_{U1} until the level of the liquid in the measure cylinder M_1 reaches the level of the liquid in the control tank C_1.

In the second step, after the liquid in the measure cylinder M_1 reaches the level of the liquid in the supply tank C_1 as shown in Fig. 2, the measure cylinder M_1 starts to move upwardly and the excess quantity of liquid in the measure cylinder M_1 above the side nozzle N_{U1} shown in Fig. 2 flows back to the supply tank C_1 and the measure cylinder M_1 contains the predetermined quantity of the liquid when the level of the liquid in the control tank C_1 and the level of the liquid in the measure cylinder M_1 are equal to the level of the side nozzle N_{U1} of the measure cylinder M_1 as shown in Fig. 3. The measure cylinder M_1 continues to move up through the state shown in Fig. 3, and the liquid begins to overflow from the measure cylinder M_1 to the mixing tank ST through the bottom nozzle N_{B1}, the overflow level setting pipe O_1 and the overflow nozzle N_{F1}, when the level of the liquid in the measure cylinder M_1 reaches the level of the overflow nozzle N_{F1} of the overflow level setting pipe O_1. The liquid continues to overflow as the measure cylinder M_1 moves up until the level of the liquid in the cylinder M_1 reaches the level of the overflow nozzle when the measure cylinder M_1 is at the highest position in its up and down motion. After the liquid has ceased to overflow as shown in Fig. 5, the measure cylinder moves down and when the level of the side nozzle N_{U1} becomes equal to the level of the liquid in the control tank C_1 the liquid begins to flow into the measure cylinder M_1 from the control tank C_1 and the measure cylinder M_1 continues to move down to the lowest position in its up and down movement while liquid flows in. The cycle is then repeated beginning from the stage shown in Fig. 2. The liquids in the tanks R_2, R_3, R_4, R_n are also added in this manner all the liquids being continuously measured and added.

In order to make the measuring and adding to the liquids smooth, the distance H_1 between the level of the liquid in the control tank C_1 and the level of the side nozzle N_{U1} of the measure cylinder M_1 at its lowest position, and the inner diameter of the flexible tube connecting the control tank C_1 with the side nozzle N_{U1} of the measure cylinder M_1 are such that the liquid flows out and in as fast as possible, for the predetermined quantity in the measure cylinder M_1 is that below the level of the side nozzle N_{U1} and the excess liquid over the level of

the side nozzle N_{F1} flows out into the control tank C_1 and others. It is also necessary to maintain the level of the liquid in the measure cylinder M_1 at the same level as that of the overflow nozzle N_{F1} of the overflow level setting pipe O_1 when liquid flows out as the measure cylinder M_1 moves up, and the speed of the measure cylinder M_1 while it is moving upwardly is selected so that the liquid flows out, keeping the liquid level in the measure cylinder nearly equal to that of the overflow nozzle The measured adding quantity of the liquid in the up and down motion cycle is represented by a formula obtained in the following manner. The variation of the level of the liquid in the control tank C_1 when excess amount of liquid in the measure cylinder M_1 has been removed is represented by

$$\frac{S_{M1} \cdot H_1}{S_{O1}+S_{O1}}$$

in which S_{C1} is the cross sectional area of the controlled portion of the control tank C_1, S_{M1} is a cross sectional area of the measure cylinder M_1, S_{O1} is the cross sectional area of the overflow level setting pipe O_1, and H_1 is the difference between the level of the liquid in the control tank C_1 at the lowest position in the up and down movement of the measure cylinder M_1 and the level of the side nozzle N_{U1} of the measure cylinder M_1. d_1 shown in Figure 3 is

$$\bar{h}_1-\left(\frac{S_{M1} \cdot \bar{H}_1}{S_{C1}+S_{O1}}\right).$$

The difference D_1 in levels between the overflow nozzle N_{F1} and the side nozzle N_{U1} of the cylinder M_1 when the liquid began to overflow through the overflow nozzle N_{F1} of the overflow level setting pipe O_2 is represented by

$$\frac{\left[\bar{h}_1-\left(\frac{S_{M1} \cdot \bar{H}_1}{S_{C1}+S_{O1}}\right)\right] \cdot S_{C1}}{S_{M1}+S_{O1}}$$

in which h_1 is the difference between the level of the liquid in the control tank C_1 and the level of the overflow nozzle N_{F1} of the overflow level setting pipe O_1 when the measuring cylinder M_1 is at its lowest level. Therefore, the measuring adding quantity of the liquid from the measure cylinder M_1, that is the overflow amount of liquid from the measure cylinder M_1 after the measure cylinder M_1 has moved to its upper limit in its up and down motion, is represented by the formula,

$$\left[\bar{L}_1-\frac{\left[\bar{h}_1-\left(\frac{S_{M1} \cdot \bar{H}_1}{S_{C1}+S_{O1}}\right)\right] \cdot S_{O1}}{S_{M1}+S_{O1}}\right] \cdot S_{M1} \cdot$$

In this case, if the liquid flowing back to the control tank C_1 from the measure cylinder M_1 flows out of the control tank C_1 because the level of the liquid is controlled to a fixed level, then

$$\left(\frac{S_{M1} \cdot H_1}{S_{C1}+S_{O1}}\right)=0$$

and the overflow quantity of liquid from the measure cylinder M_1, that is the measured addition liquid, is represented by the formula

$$\left[L_1-\left(\frac{\bar{h}_1 \cdot S_{O1}}{S_{M1}+S_{O1}}\right)\right] \cdot S_{M1}$$

When measuring liquids with a receptacle having a definite capacity such as the measure cylinder M_1 the level control error and the cross sectional area of the measure cylinder at the controlled level should be made small or the resulting effect should be made small in order to make the measure error of the capacity of the measuring receptacle small.

In the present invention, as is obvious from the above formulae, the effect of variations of H_1 and h_1 produced by variations of (H_1+h_1) and the effect of variations of the level of the liquid in the control tank C_1 on the measured quantity of liquid is much reduced if S_{C1}, S_{M1} and S_{O1} follow the law $S_{C1} \gg S_{M1} \gg S_{O1}$. The error in the measured quantity of the liquid is dependent on the difference L_1 between the level of the side nozzle N_{U1} of the measure cylinder M_1 at the highest position in its up and down movement and that of the overflow nozzle N_{F1} of the overflow level setting pipe O_1, the cross section of the measure cylinder M_1 at the level of the side nozzle N_{U1}, and the cross section of the measure cylinder M_1 at the level of the overflow nozzle N_{F1} when the measure cylinder M_1 is at the highest position in its up and down movement.

As the liquid is intermittently supplied to the measure cylinder and added, the measuring quantity of the liquid at one cycle is able to be made large. Thus, if the difference L_1 in levels is determined taking into consideration of the error of setting the highest position of the up and down movement of the measure cylinder M_1 and the relation of the difference L_1 with the cross sectional area of the measure cylinder M_1 at the level of its overflow nozzle N_{F1}, the difference L_1 becomes sufficiently large and the relative error is de-

termined only with the control error of the difference L_1 without being affected by the level control error of the control tank C_1, thereby making the measure relative error sufficiently small.

The quantity of liquid dispensed can be regulated as described above by regulating the up and down movement of the overflow level setting pipe, by changing the measure cylinder M_1 and by varying the upper limit of the up and down movement of the measure cylinder M_1, and can also regulate by varying the level of the overflow level setting pipe O_1. Therefore, particularly strict consideration of the error of the inner diameter of the measure cylinder M_1, the error of the fixed position of the side nozzle N_{U1} of the measure cylinder M_1 and the error of the inner diameter of the overflow level setting pipe O_1 is not necessary. As already stated the regulation of the predetermined quantity of the liquid when setting the quantity of the measured liquid can be made by varying the level of the overflow level setting pipe O_1 and sufficient accuracy is given by this regulation.

In the mixing process of the coating solution for manufacturing the photosensitive material, the coating solution completed by mixing together the measured and added liquids must have little coagulation caused by interaction between the gelatin and addition agents on account of local unevenness of the density of the liquid, and only very small bubbles made by stirring and adding and by being uniformly mixed in the mixing tank ST. If the coagulation and small bubbles referred to are noticable in the coating solution, it greatly affects the quality of the photographic material, makes uniform coating impossible in the subsequent coating process and makes the manufacturing of the photosensitive material impossible. During the manufacture of the coating solution the extent of coagulation and the number of small bubbles uniformly formed in the mixing tank ST, the factor which affects the uniformity of the liquid, depend on the adding speed when mixing in the mixing tank ST and the stirring method of the coating solution in the mixing tank ST. As for the adding speed of the liquids, the flowing out speed of the liquid depends on the speed of the measure cylinder M_1 during its upward motion which is selected taking into consideration the inner diameter of the flexible tube connecting the bottom nozzle N_{B1} of the measure cyclinder M_1 with the overflow level setting pipe O_1, and by disposing the overflow nozzle N_{P1} of the overflow level setting pipe O_1 at the same level as the level of the liquid in the measure cylinder M_1 as described above. Thus, the adding speed of the liquids into the mixing tank ST can be set in response t the properties of, and added quantity of, the liquid by regulating the speed of the measure cylinder M_1 when moving upwardly, thereby making it possible to add the liquid without pulsation so that it is suitable for manufacturing a uniformly mixed coated compound. Moreover it is possible to add some addition agents at the same time if the addition agents do not interact and if there is no limitation to the adding order and adding interval, and it is possible to measure and add some liquids at a time by moving the measure cylinders thereof up and down with an up and down moving mechanism, whereby the manufacturing apparatus is made simple and the care thereof is made easy. During the manufacture of the photosensitive material, the mixture and the liquids should be kept in a constant temperature in order to maintain the properties of the liquid emulsion, gelatin solution and the completed coating solution and to prevent the gelatin thereof. Therefore, at the time of adding, the addition liquids and solutions must also be kept at the same temperature as the coating solution.

Nevertheless, there are some addition agents which cannot be kept at the same temperature as the temperature of the coating solution on account of their chemical properties. These addition agents should be heated just before adding. In this apparatus a separate heat exchange device is not needed if the control tank has a jacket.

Moreover in this apparatus as the measured quantity of the liquid is variable by moving up and down the overflow level setting pipe, an automatic manufacturing apparatus for photosensitive material applicable to a wide range of kinds of materials and having high accuracy in measuring can be made by coupling the manufacturing apparatus in accordance with the present invention to a suitable automatic level setting mechanism and a computer.

Fig. 6 is a schematic view illustrating a control device adapted to be used with the apparatus embodying the present invention. In Fig. 6 the reference characters R_1—R_n denote the supply tanks for the liquids and solutions, T_1—T_n denote supply tanks for the addition liquids and solutions for regulating the properties of the mixture, C_1—C_n denote the control tanks of the liquids M_1—M_n denote the measure cylinders of the liquids O_1—O_n denote the overflow level setting pipes, ST denotes a mixing tank, S_1—S_n denote the supply selecting means for the liquids, V_{O1}—V_{On} denote addition liquid controlling valves for regulating the properties of the mixture, and X_1—X_n, Y_1—Y_n, Z_1—Z_n denote controlling devices not described in detail.

In order to operate the mixture manufacturing apparatus in accordance with the

present invention in a full automatic condition, three systems of controlling devices are required. One of the three systems is represented by the controlling device system X_1—X_n, which operates the up and down moving mechanism according to the predetermined adding order and adding interval, another of the three systems is represented by Y_1—Y_n which opens and closes the supply kinds selecting means and moving up and down the overflow level setting pipe according to the predetermined required composition of the mixture, and the third of the three systems is represented by the controlling device system Z_1—Z_n which detects the variation of the controlled physical properties of the mixed coating solution and controls the physical properties operating the controlling valves V_{c1}—V_{cn}.

With the above three systems of the controlling devices, fully automatic manufacturing of the mixture is possible, but only with the controlling device system X_1—X_n and the object can be achieved by controlling sufficiently the density of the addition liquids and solutions and by manually moving up and down the overflow level setting pipes.

Moreover by adopting the manufacturing method described in which measuring and adding is effected by a measuring cylinder which is reciprocated, many automatic valves are eliminated and the liquid is measured and added with little error of level control so that a reliable and continuously operable fully automatic mixture manufacturing apparatus is realized, and the solution is mixed in steady conditions with few operators required.

With the apparatus described above, a similar result to a completely continuous manufacturing method is gained, fluctuation of the physical properties of the mixture and switching operation of the tanks being eliminated. The problem of the quality of the mixture in the process of manufacturing a mixture requiring economy for increasing productivity, such as in a process of mixing a photographic material where the coating speed is increased, and the problem of the quality of the mixture in a process of manufacturing a mixture wherein the composition proportions of the mixture vary, such as a photographic material wherein the proportion of the silver halide increases according to the advancement thereof, are able to be solved in accordance with the present invention.

The invention will be further illustrated by the following Examples.

EXAMPLE 1.

A coating solution for an anti-halation layer had the composition:—

	Parts
gelatin solution	100
dye solution	15
coating assistant solution	15
hardener solution	15
water and others	50

This solution was mixed by operating continuously the manufacturing apparatus described hereinbefore, the capacity of the mixing tank being 10 kg. and the period of mixing in the mixing tank 5—10 minutes.

The viscosity, specific gravity, electric conductivity and colour tone of the completed coated solution were measured, and their values were within the standard limits.

EXAMPLE 2.

A photographic emulsion for the negative emulsion layer had the composition:—

	Parts
liquid emulsion	100
Colour-sensitizer and stabilizer solution	15
coating assistant solution	15
hardener solution	20
water and others	50

This emulsion was mixed by operating continuously the manufacturing apparatus described hereinbefore, the capacity of the mixing tank being 10 kg. and the period of mixing in the mixing tank being 5—10 minutes.

The values of the viscosity, specific gravity, and electric conductivity of the complete emulsion were continuously measured and formed to be within the standard limits. The photographic characteristics of the completed emulsion were entirely uniform.

WHAT WE CLAIM IS:—

1. A method of preparing a mixture of a plurality of liquids in an apparatus comprising a mixture tank and, for each liquid, a control tank the liquid level in which is controlled, a measure cylinder having at its upper end a nozzle connected to the lower end of the control tank and a further nozzle at its lower end, and an overflow level setting pipe which is connected at its lower end to the nozzle at the lower end of the measure cylinder and which has an overflow nozzle leading to the mixture tank, the method comprising adding each liquid to the mixing tank by moving the appropriate measure cylinder downwardly to the extent that the nozzle at the upper end of the measure cylinder is below the liquid level of the associated control tank and subsequently moving the measure cylinder upwardly to the extent that the nozzle at the upper end of the measure

cylinder is above the overflow nozzle of the associated overflow level setting pipe, the liquids being added in a predetermined order and at predetermined intervals, mixing the liquids in the mixing tank by stirring, and forwarding the mixed mixture continuously to the next process.

2. Apparatus for preparing a mixture of a plurality of liquids comprising a mixing tank and, for each liquid, a control tank the liquid level of which is controlled, a measure cylinder having a nozzle at its upper end which is connected to the lower end of the control tank, and a nozzle at its lower end, and an overflow setting pipe the lower end of which is connected to the nozzle at the lower end of the measure cylinder and which has an overflow nozzle which leads to the mixing tank, an actuating means for each measure cylinder for moving that measure cylinder downwardly to the extent that the nozzle at its upper end is below the liquid level in the associated control tank and for subsequently moving that measure cylinder upwardly so that the nozzle at its upper end is above the overflow nozzle of the associated overflow level setting pipe, means for mixing the liquids in the mixing tank, and means for forwarding the mixed liquids continuously to a further process.

3. Apparatus as claimed in Claim 2 which comprises means for automatically operating said actuating means in a predetermined order and at predetermined intervals.

4. A method of preparing a mixture of a plurality of liquids substantially as hereinbefore described with reference to the accompanying drawings.

5. Apparatus for preparing a mixture of a plurality of liquids substantially as hereinbefore described with reference to the accompanying drawings.

6. Mixtures of a plurality of liquids, when prepared by a method as claimed in claim 1 or 4 or in apparatus as claimed in any of claims 2, 3 or 5.

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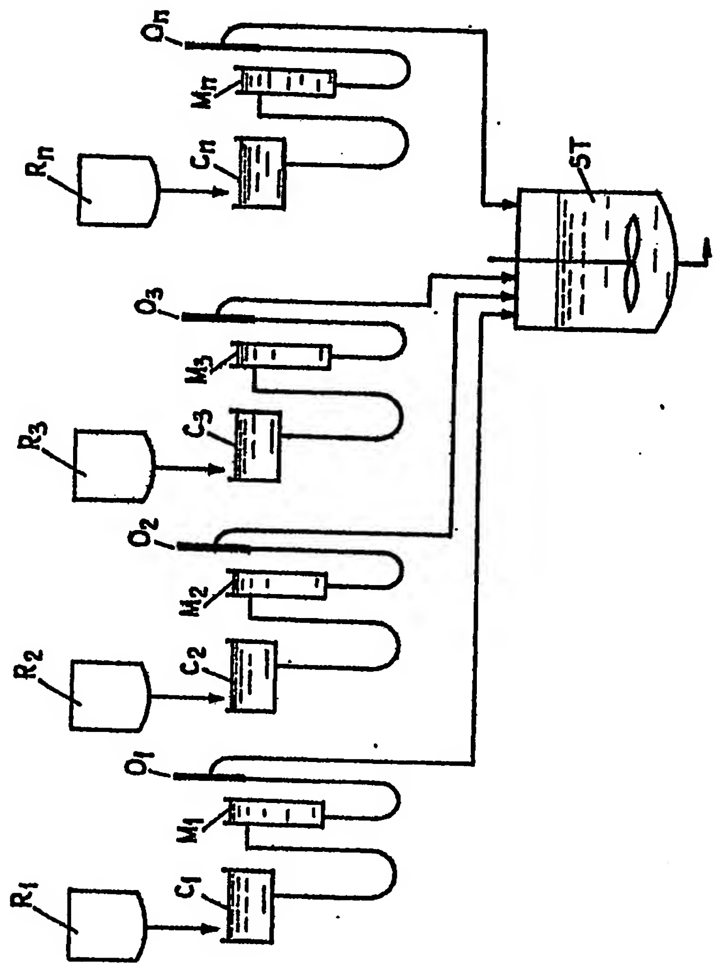

Fig. 1.

Fig. 2.

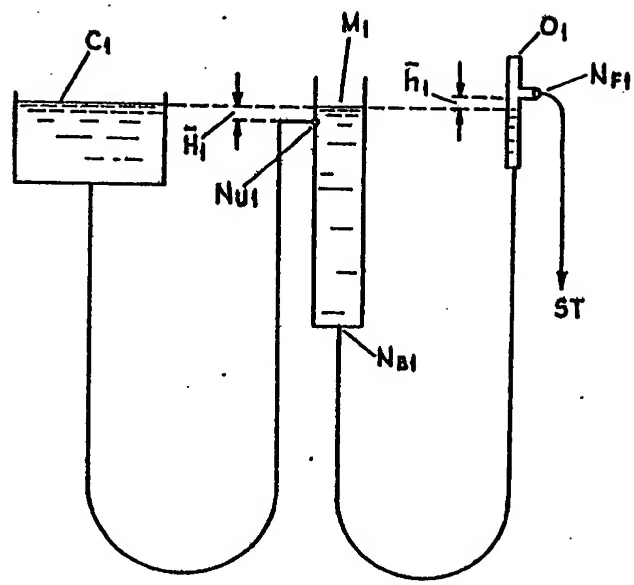

Fig. 3.

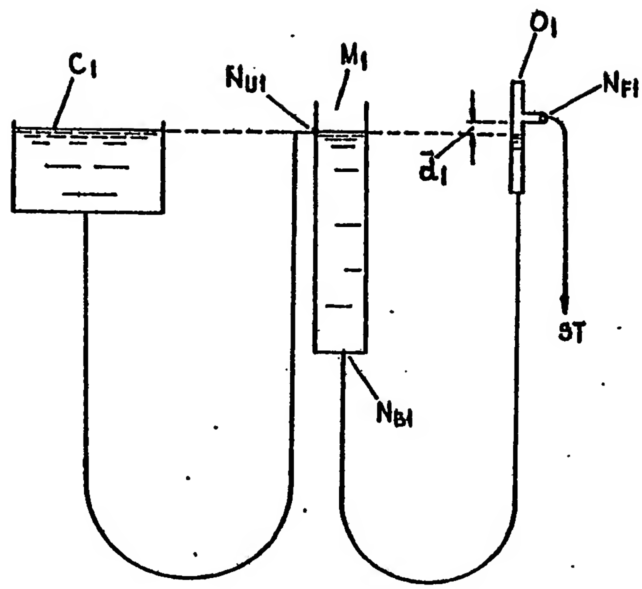

Fig. 4.

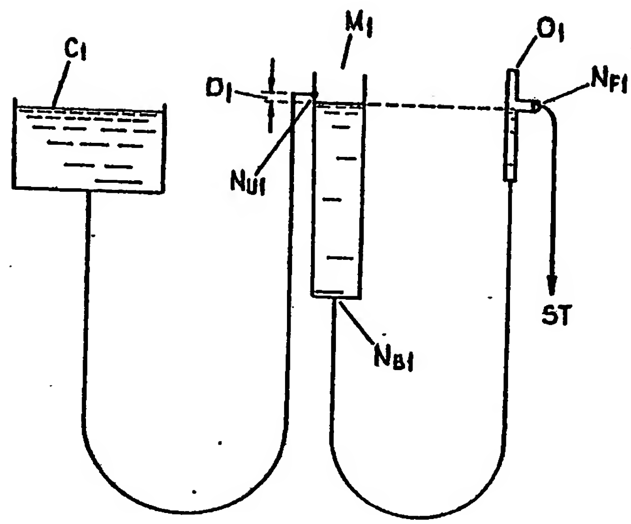

Fig. 5.

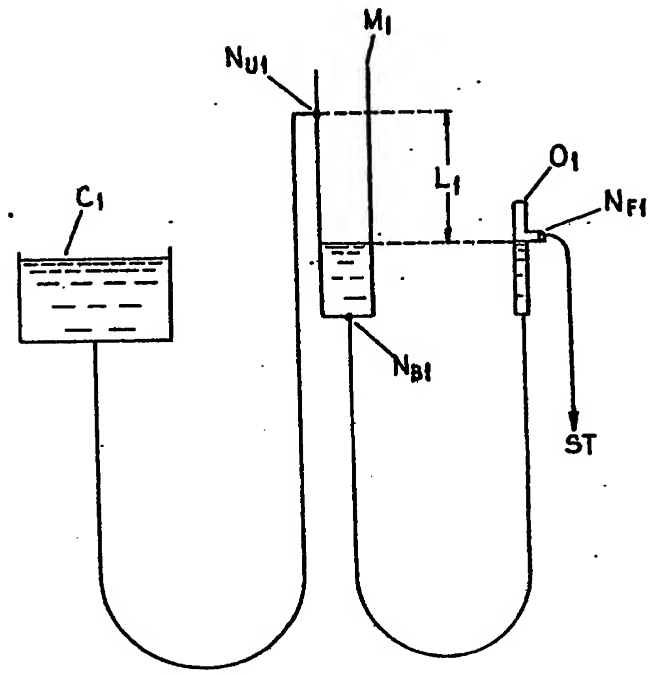

Fig. 6.